

airfoil portion **52** to provide fixed support structure between the core engine case structure **46** and the fan case structure **48**. The axis of rotation **60** may be located about the geometric center of gravity (CG) of the airfoil cross section. An actuator system **62** (illustrated schematically; FIG. 1A), for example only, a unison ring operates to rotate each fan exit guide vane **50** to selectively vary the fan nozzle throat area (FIG. 2B). The unison ring may be located, for example, in the intermediate case structure such as within either or both of the core engine case structure **46** or the fan case **48** (FIG. 1A).

[0044] In operation, the FEGV system **36** communicates with the controller C to rotate the fan exit guide vanes **50** and effectively vary the fan nozzle exit area **44**. Other control systems including an engine controller or an aircraft flight control system may also be usable with the present invention. Rotation of the fan exit guide vanes **50** between a nominal position and a rotated position selectively changes the fan bypass flow path **40**. That is, both the throat area (FIG. 2B) and the projected area (FIG. 2C) are varied through adjustment of the fan exit guide vanes **50**. By adjusting the fan exit guide vanes **50** (FIG. 2C), bypass flow B is increased for particular flight conditions such as during an engine-out condition. Since less bypass flow will spill around the outside of the fan nacelle **34**, the maximum diameter of the fan nacelle required to avoid flow separation may be decreased. This will thereby decrease fan nacelle drag during normal cruise conditions and reduce weight of the nacelle assembly. Conversely, by closing the FEGV system **36** to decrease flow area relative to a given bypass flow, engine thrust is significantly spoiled to thereby minimize or eliminate thrust reverser requirements and further decrease weight and packaging requirements. It should be understood that other arrangements as well as essentially infinite intermediate positions are likewise usable with the present invention.

[0045] By adjusting the FEGV system **36** in which all the fan exit guide vanes **50** are moved simultaneously, engine thrust and fuel economy are maximized during each flight regime. By separately adjusting only particular fan exit guide vanes **50** to provide an asymmetrical fan bypass flow path **40**, engine bypass flow may be selectively vectored to provide, for example only, trim balance, thrust controlled maneuvering, enhanced ground operations and short field performance.

[0046] Referring to FIG. 3A, another embodiment of the FEGV system **36'** includes a multiple of fan exit guide vane **50'** which each includes a fixed airfoil portion **66F** and pivoting airfoil portion **66P** which pivots relative to the fixed airfoil portion **66F**. The pivoting airfoil portion **66P** may include a leading edge flap which is actuable by an actuator system **62'** as described above to vary both the throat area (FIG. 3B) and the projected area (FIG. 3C).

[0047] Referring to FIG. 4A, another embodiment of the FEGV system **36''** includes a multiple of slotted fan exit guide vane **50''** which each includes a fixed airfoil portion **68F** and pivoting and sliding airfoil portion **68P** which pivots and slides relative to the fixed airfoil portion **68F** to create a slot **70** vary both the throat area (FIG. 4B) and the projected area (FIG. 4C) as generally described above. This slatted vane method not only increases the flow area but also provides the additional benefit that when there is a negative incidence on the fan exit guide vane **50''** allows air flow from the high-pressure, convex side of the fan exit guide vane **50''** to the lower-pressure, concave side of the fan exit guide vane **50''** which delays flow separation.

[0048] The use of the gear reduction **22** allows control of a number of operational features in combination to achieve improved fuel efficiency. In one embodiment, the expansion ratio (or pressure ratio) across the low pressure turbine, which is the pressure entering the low pressure turbine section divided by the pressure leaving the low pressure turbine section was greater than or equal to about 5.0. In another embodiment, it was greater than or equal to about 5.7. In this same combination, the bypass ratio was greater than or equal to about 8.0. As mentioned earlier, in other embodiments, the bypass ratio may be greater than 10.0. In these same embodiments, the gear reduction ratio is greater than or equal to about 2.4 and less than or equal to about 4.2. Again, in embodiments, it is greater than 2.5.

[0049] This combination provides a low pressure turbine section that can be very compact, and sized for very high aerodynamic efficiency with a small number of stages (3 to 5 as an example). Further, the maximum diameter of these stages can be minimized to improve installation clearance under the wings of an aircraft.

[0050] The foregoing description is exemplary rather than defined by the limitations within. Many modifications and variations of the present invention are possible in light of the above teachings. The preferred embodiments of this invention have been disclosed, however, one of ordinary skill in the art would recognize that certain modifications would come within the scope of this invention. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described. For that reason the following claims should be studied to determine the true scope and content of this invention.

What is claimed is:

1. A gas turbine engine comprising:

a core section defined about an axis, a fan section delivering a first portion of air into the core section, and a second portion of air into a bypass duct, a bypass ratio being defined as the ratio of the second portion compared to the first portion, and said bypass ratio being greater than or equal to about 8.0; and

the air delivered into the core section being delivered into a low pressure compressor, and then into a high pressure compressor, air from the high pressure compressor being delivered into a combustion section where it is mixed with fuel and ignited, and products of the combustion from the combustion section passing downstream over a high pressure turbine section and then a low pressure turbine section, and an expansion ratio across the low pressure turbine section being greater than or equal to about 5.0, said low pressure turbine section driving said low pressure compressor section, and driving said fan through a gear reduction, with said gear reduction having a gear ratio greater than or equal to about 2.4.

2. The gas turbine engine as set forth in claim 1, wherein said gear ratio is greater than or equal to about 2.5.

3. The gas turbine engine as set forth in claim 1, wherein said gear ratio is less than or equal to about 4.2.

4. The gas turbine engine as set forth in claim 1, wherein said expansion ratio is greater than or equal to about 5.7.

5. The gas turbine engine as set forth in claim 1, wherein said bypass ratio is greater than or equal to 10.